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Trends and challenges in sediment research 2008: the role of sediments in river basin management

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This is the first editorial of an annual series. In it, we identify some of the forward-looking articles which appeared in JSS over the past two volumes and then continue to highlight recent global trends in sediment research.

For the past 2 years, there has been an increase in publications which emphasize the fact that sediment is an integral and dynamic part of aquatic system and that it plays a major role in the hydrological, geomorphological, and ecological functioning of river basins. Here, disciplines such as slope geomorphology, fluvial sedimentology, coastal and marine sedimentology, and coastal management combine to assess interlinked issues of sediment production, transport, and accumulation (Perry and Taylor 2007; JSS book review by Förstner 2007). Central aspects are sediment dynamics and the interactions between sediment and pollutants in river systems (Westrich and Förstner 2007; JSS book review by Owens and Petticrew 2008). The river basin represents an appropriate scale for management because, in many cases, source control will be the optimal long-term solution: environmentally, socially, and economically (Salomons 2008). Climate changes are expected to change regional hydrology and cause changes in erosion,

transport, and deposition of sediments; plausible land-use changes can be interfaced with natural science and socioeconomic models to assess the impact on sediment quality (Salomons 2005). In the EuroCat project (Salomons 2004), catchment changes and their impact on the coast were studied on seven systems covering all coastal types (except for fjords) in Europe and different socioeconomic settings.

Many articles of the past two JSS volumes dealt with sediment toxicity studies and in particular with elucidating the complex mixture of potential hazardous compounds in sediments (JSS Subject Area Sediments, Section 1 ‘Sediment Quality and Impact Assessment’):

- The critical body residue (CBR) concept was elaborated using an oligochaete worm in sediments spiked with Cd, Cr, Cu, and Pb (Penttinen et al. 2008).
- Genotoxicity studies in Rhine sediments resulted in valuable information on specific properties of genotoxicants and their bioavailability (Kosmehl et al. 2007).
- Oil pollution results in complex mixture of hydrocarbons which cannot be resolved by conventional gas chromatography, assessing their potential toxic effects was detailed by spiking whole oil to estuarine sediments (Scarlett et al. 2007).
- Effect-directed analysis (EDA) protocols are based on small amounts of sediments; however, to obtain sufficient material for subsequent biotesting a large volume Tenax extraction method was developed (Schwab and Brack 2007).

Sediment management challenges and problems relate to quantity and quality issues, the latter comprising subjects such as contamination, legislation, risk perception, and assessment, source control, and destination of dredged

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material (Section 2 ‘Sediment Risk Assessment and Communication’ and Section 3 ‘Sediment Management at the River Basin Scale’):

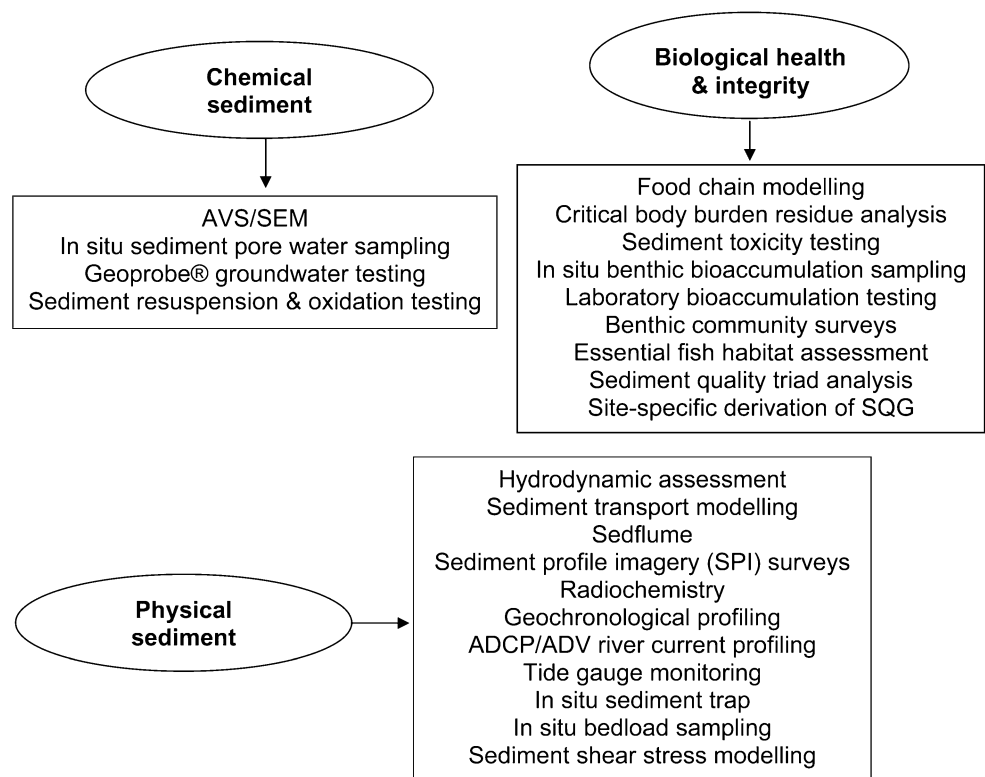
- A classical question but a new approach for using sediment cores to investigate the contamination history of a river was elaborated by Bábek et al. (2008).
- Many data exist on the desorption of heavy metals but very few on organic micropollutants: The study on desorption of dieldrin from aged sediments fills in this gap; in addition, desorption is related to flood events (Smit et al. 2008).
- Relatively few articles have appeared on sediment dynamics in catchments; however, the study on the impact of sediment deficits in the Netherlands gives a nice introduction to this important question; in addition, it addresses decadal changes (Van der Meulen et al. 2007).
- While policy questions surrounding sediment contamination are mostly discussed in the commentary section (Quevauviller 2007; Förstner 2008a), there is a research original article by Slob and Gerrits (2007) showing the whimsicality of policy processes involving sediments.

The final management strategy, apart from economic and social factors, mainly involves engineering elements such as technical feasibility, contaminant reduction, and permanence of remedial options like capping, in situ treatment,

and dredging and disposal (Section 4 ‘Sediment and Dredged Material Treatment’). A critical review of recent developments was made by Förstner and Apitz (2007) on the basis of the presentations at the 4th Battelle Conference of Sediment Remediation (Foote and Durrell 2007). Actually, the United States have a leading position due to the efforts under the Superfund Act (U.S. EPA 2005). An increasing use of comparative risk assessments considers all risks of a remedial option; these assessments include a wide spectrum of methods (Fig. 1, after Wenning et al. 2007) and range from initial site analysis up to long-term monitoring of technological performance and ecological effects. JSS will continue the cooperation with the Battelle Conference series, which represents the state-of-the-art of emerging technologies, science and management issues for contaminated sediment remediation (Young 2008).

In Europe, sediment issues have developed reasonably under the Water Framework Directive following an initial underestimation by the water authorities and regulatory bodies of the practical problems with this medium (Förstner 2002). The successful installation of the ‘Demand-driven European Sediment Research Network (SedNet)’ provides a common platform for both researchers and practitioners in this field (Brils 2002; Den Besten et al. 2003). Two studies on the impact of historical contaminated sediments, on the Rhine and Elbe rivers, were initiated by ports and required a practical approach to river basin management (Heise and

Fig. 1 Studies contributing to risk analysis (after a design of ENVIRON, Wenning et al. 2007)



Förstner 2007). The objectives of sustainable management of sediment resources at the river basin scale are described in two SedNet books: ‘Sediment Risk Management and Communication’ (edited by Susanne Heise 2006) and ‘Sediment Management at the River Basin Scale’ (edited by Phil Owens, 2008; JSS book review by Förstner 2008b). Examples of recent initiatives for improved sediment management within Europe include national and multinational scientific research projects such as EU AquaTerra (2007) and EU-RiskBase (2007). JSS regularly reported from the International SedNet Conferences: The 4th SedNet Conference at Venice focused on two themes, the round table on sediments in river basin management plans (Netzband et al. 2007) and sediment linkages between the river catchment and the sea (JSS Vol 7, No 5 edited by Owens 2007). The 5th Conference at Oslo, May 27th–29th, 2008 had a wide spectrum of themes from surveys, quality standards, emerging issues, and case studies in sediment management with a special focus on sediment remediation; a JSS issue is planned for June 2009 (edited by Gijs Breedveld, Subject Editor in JSS Sediment Area, section 4).

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